

WHAT IS CLAIMED IS

1. An automated directory assistance system, comprising:

a speech recognition module configured to receive an audible request for a telephone number from a caller and generate a transcript from the audible request;

a listing retrieval module configured to retrieve at least one listing corresponding to the

5 audible request from a database using the transcript; and

an accept/reject module configured to determine whether to accept one or more of the listings retrieved by the listing retrieval module and present a telephone number corresponding to the accepted one or more listings to the caller.

2. The system of claim 1, wherein the speech recognition module includes a large

vocabulary speech recognizer.

3. The system of claim 1, wherein the speech recognition module is configured to use

acoustic models and an n-gram grammar to recognize at least one word included in the audible request.

4. The system of claim 1, wherein the listing retrieval module includes a statistical information retrieval system.
5. The system of claim 1, wherein the listing retrieval module is configured to use the transcript as a query into the database to retrieve the at least one listing.
6. The system of claim 1, wherein the listing retrieval module is configured to rank listings from the database when the listing retrieval module retrieves a plurality of the listings.
7. The system of claim 1, wherein the accept/reject module is configured to identify at least one word that is required for each of the listings, determine whether the transcript contains the identified at least one word, and accept one of the listings when the transcript contains the identified at least one word with sufficient acoustic confidence.
8. The system of claim 1, wherein the accept/reject module is further configured to transfer the audible request to a human operator when the accept/reject module accepts none of the listings.
9. The system of claim 1, further comprising:

a training system configured to automatically configure the speech recognition module, the listing retrieval module, and the accept/reject module.

10. The system of claim 9, wherein the training system includes:

an acoustic model training module configured to estimate acoustic models from training transcripts relating to requests for telephone numbers, and

5 a speech grammar estimation module configured to create an n-gram grammar for the telephone numbers, the speech recognition module using the acoustic models and the n-gram grammar to generate the transcript from the audible request.

11. The system of claim 9, wherein the training system includes:

a listings statistics estimation module configured to identify words used when requesting a particular telephone number, the listing retrieval module retrieving the words for the telephone number using the transcript.

12. The system of claim 9, wherein the training system includes:

5 a required words determination module configured to identify at least one word that is required to request a particular telephone number, the accept/reject module using the identified at least one word to determine whether a corresponding one of the listings is acceptable.

13. The system of claim 9, wherein the training system includes:
a transcription module configured to automatically generate training transcripts
corresponding to prior requests for telephone numbers.
14. The system of claim 13, wherein the transcription module includes:
a grammar creation component configured to create a loose grammar
corresponding to each of the telephone numbers, and
a speech recognition component configured to generate a training transcript for
one of the prior requests using the loose grammar.
15. The system of claim 14, wherein the transcription module further includes:
an accept/reject component configured to determine whether the generated
training transcript is acceptable.
16. The system of claim 15, wherein the transcription module further includes:
a verification/correction module configured to present the generated training
transcript to a human for at least one of verification and modification.

17. A method for providing directory assistance, comprising:

receiving an audible request for a telephone number from a caller;

generating a transcript from the audible request;

retrieving at least one listing corresponding to the audible request from a database using

5 the transcript as a query into the database;

determining whether to accept one or more of the retrieved listings; and

presenting a telephone number corresponding to the accepted one or more listings to the

caller.

18. The method of claim 17, further comprising:

estimating acoustic models from speech and training transcripts relating to requests for

telephone numbers; and

creating an n-gram grammar for the telephone numbers.

19. The method of claim 18, wherein the generating includes:

using the acoustic models and the n-gram grammar to recognize at least one word

included in the audible request.

20. The method of claim 17, further comprising:

identifying words relating to each of a plurality of telephone numbers; and

storing the words in the database.

21. The method of claim 20, wherein the retrieving includes:

using the transcript as a query into the database to retrieve the words relating to the telephone number.

22. The method of claim 17, wherein the retrieving includes:

ranking listings from the database when a plurality of the listings are retrieved.

23. The method of claim 17, wherein the determining includes:

identifying at least one word that is required for each of the retrieved listings,

determining whether the transcript contains the identified at least one word, and

accepting one of the retrieved listings when the transcript contains the identified at least

5 one word.

24. The method of claim 17, further comprising:

transferring the audible request to a human operator when none of the retrieved listings are accepted.

25. The method of claim 17, further comprising:
automatically generating training transcripts corresponding to prior requests for telephone numbers.
26. The method of claim 25, wherein the automatically generating includes:
creating a loose grammar corresponding to each of the telephone numbers, and
generating a training transcript for one of the prior requests using the loose grammar.
27. The method of claim 26, wherein the automatically generating further includes:
determining whether the generated transcript is acceptable.
28. The method of claim 27, wherein the automatically generating further includes:
presenting the generated transcript to a human for at least one of verification and modification.
29. A system for providing automated directory assistance, comprising:
means for receiving a request for a telephone number from a caller;

means for generating a transcript from the request;

means for retrieving a listing corresponding to the request from a database using the

5 transcript as a query into the database;

means for determining whether to accept the retrieved listing; and

means for presenting a telephone number corresponding to the accepted listing to the

caller.

30. A computer-readable medium that stores instructions executable by at least one processor to perform a method for providing directory assistance, comprising:

recognizing at least one word in an audible request for a telephone number received from a caller;

5 retrieving at least one listing corresponding to the audible request from a database using the at least one word as a query into the database;

determining whether to accept one or more of the retrieved listings; and

presenting a telephone number corresponding to the accepted one or more listings to the caller.

31. A system for generating transcripts used to configure an automated directory assistance service, comprising:

a grammar creation component configured to create a loose grammar for each of a plurality of telephone numbers using a plurality of grammar rules and a plurality of general phrases; and

5 a speech recognition component configured to generate a transcript of a directory assistance call using the loose grammar.

32. The system of claim 31, wherein the grammar creation component is configured to create the loose grammar by identifying plausible words for referring to each of the telephone numbers.

33. The system of claim 31, wherein the speech recognition component is configured to recognize words spoken during the directory assistance call.

34. The system of claim 31, further comprising:
an accept/reject component configured to determine whether the generated transcript is acceptable.

35. The system of claim 34, wherein the accept/reject component uses confidence scores to determine whether to accept or reject the generated transcript.

36. The system of claim 34, further comprising:

a verification/correction module configured to present the generated transcript to a human for at least one of verification and modification.

37. A method for generating transcripts used to configure an automated directory assistance service, comprising:

creating a loose grammar for each of a plurality of telephone numbers using a plurality of grammar rules and a plurality of general phrases;

generating a transcript of a directory assistance call using the loose grammar and knowledge of a telephone number that was given out by a human operator for the directory assistance call;

producing a confidence score for the generated transcript; and

determining whether the generated transcript is acceptable based on the confidence score for the generated transcript.

38. The method of claim 37, wherein the creating includes:

identifying possible words or phrases for referring to each of the telephone numbers.

39. The method of claim 37, wherein the generating includes:

recognizing words spoken during the directory assistance call.

40. A computer-readable medium configured to store instructions executable by at least one processor to perform a method for generating transcripts used by an automated directory assistance service, comprising:

identifying plausible words for referring to each of a plurality of telephone numbers;

5 creating a loose grammar for each of the telephone numbers using the identified words;

and

generating a transcript of a directory assistance call using the loose grammar and a telephone number given out by a human operator for the directory assistance call.

41. A training system for training an automated directory assistance service, comprising:

a transcription module configured to obtain transcripts relating to directory service requests;

5 a speech grammar estimation module configured to create an n-gram grammar for a plurality of telephone numbers from the transcripts;

a listings statistics estimation module configured to identify words used to refer to each of the telephone numbers from the transcripts; and

a required words determination module configured to identify at least one word that is

10 required to request each of the telephone numbers from the transcripts.

42. The training system of claim 41, wherein the transcription module includes:

a grammar creation component configured to create a loose grammar for each of the telephone numbers using a plurality of grammar rules and a plurality of general phrases, and

5 a speech recognition component configured to generate a transcript for each of the directory service requests using the loose grammar.

43. The training system of claim 41, further comprising:

an acoustic model training module configured to estimate acoustic models used in speech recognition from the transcripts.

44. The training system of claim 41, wherein the listings statistics estimation module is configured to store the identified words in a document associated with a corresponding one of the telephone numbers.

45. The training system of claim 41, wherein the required words determination module is configured to count the number of times each word or phrase has been previously used to refer

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to one of the telephone numbers and identify the word or phrase as a required word or phrase

when the count reaches a predetermined number or percentage of the transcripts.

46. A method for training an automated directory assistance service, comprising:

obtaining transcripts relating to directory service requests;

creating an n-gram grammar for a plurality of telephone numbers from the transcripts;

determining words used to refer to each of the telephone numbers from the transcripts;

5 and

identifying at least one word that is required to request each of the telephone numbers from the transcripts.

47. The method of claim 46, wherein the obtaining includes:

creating a loose grammar for each of the telephone numbers using a plurality of

grammar rules and a plurality of general phrases, and

generating a transcript for each of the directory service requests using the loose

5 grammar and a telephone number given out by a human operator.

48. The method of claim 46, further comprising:

estimating acoustic models used in speech recognition from the transcripts.

49. The method of claim 46, wherein the determining includes:
storing the identified words in a document associated with a corresponding one of
the telephone numbers.

50. The method of claim 46, wherein the identifying includes:
counting the number of times each word or phrase has been previously used to
refer to one of the telephone numbers, and
identifying the word or phrase as a required word or phrase when the count
reaches a predetermined number or percentage of the transcripts.

51. A computer-readable medium that stores instructions executable by at least one
processor to perform a method for training an automated directory assistance service, comprising:
obtaining transcripts relating to directory service requests;
creating an n-gram grammar for a plurality of telephone numbers from the transcripts;
determining words used to refer to each of the telephone numbers from the transcripts;
and
identifying at least one word that is required to request each of the telephone numbers
from the transcripts.

52. A directory assistance system, comprising:

a training system including:

5 a transcription module configured to obtain training transcripts relating to

directory service requests,

10 a speech grammar estimation module configured to create an n-gram grammar for

a plurality of telephone numbers from the training transcripts,

15 a listings statistics estimation module configured to identify words used to refer to each of the telephone numbers from the training transcripts and store the words as listings in a database, and

20 a required words determination module configured to identify at least one word that is required to request each of the telephone numbers from the training transcripts; and a directory assistance system including:

25 a speech recognition module configured to receive an audible request for a telephone number from a caller and generate a transcript from the audible request using the n-gram grammar,

30 a listing retrieval module configured to retrieve at least one listing corresponding to the audible request from the database using the transcript, and

35 an accept/reject module configured to determine whether to accept the listing retrieved by the listing retrieval module based on the at least one required word of sufficiently high confidence and present a telephone number corresponding to the accepted listing to the caller.

53. A method for providing a directory assistance service, comprising:
- receiving a request for a telephone number from a caller, the request being spoken by the caller and including a location and listing corresponding to the telephone number;
- using large vocabulary speech recognition to recognize at least one word spoken by the
- 5 caller when making the request;
- using statistical information retrieval to identify a listing corresponding to the recognized word;
- determining whether the listing is likely to be correct; and
- providing a telephone number corresponding to the listing to the caller.
54. A method for providing a directory assistance service, comprising:
- receiving a request for a telephone number from a caller, the request being spoken by the caller and including a location and listing corresponding to the telephone number;
- using large vocabulary speech recognition to recognize at least one word spoken by the
- 5 caller when making the request;
- using statistical information retrieval to identify a listing corresponding to the recognized word; and
- connecting the caller to a called party corresponding to the listing.